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AMERICA'S RANGE -THE SEQUEL
Electronic Proving Ground

Colonel Hugo Keyner, Commander, and Mr. Jim Cole, Deputy to the Commander, WSMR-Electronic Proving Ground

The DTC Technology Report for December 2000 featured AMERICA'S RANGE at White Sands Missile Range (WSMR), NM. There is more to the story! It is appropriate that this initial 2001 report address the other segment of AMERICA'S RANGE, highlighting the capabilities of WSMR's Electronic Proving Ground (EPG) at Fort Huachuca, AZ. These capabilities support its position as the Army's premier Command, Control, Communications, Computer, Intelligence, and Electronic Warfare (C4IEW) tester. ***NOTE: BOLD print identifies topics for which additional details are provided within this report.***

Located in the high desert 70 miles southeast of Tucson, Fort Huachuca is positioned in a valley with mountains in every direction, providing a relatively quiet electromagnetic environment, uniquely suitable for C4IEW testing. Isolation from radio frequency noise was the primary reason for the 1954 selection of Fort Huachuca as the site for EPG.

Fort Huachuca's high desert, an ideal setting for testing battlefield electronic systems

With sufficient range space to provide realistic deployment and dispersion of a division slice of digital battlefield systems, EPG is uniquely capable of performing tests of large C4IEW systems. Adding in the special strengths and talents of the Fort Hood, TX, and Fort Lewis, WA, field offices enables a unique capability which has benefited both developmental testing (DT) and operational testing (OT). EPG supports the U.S. Army Test and Evaluation Command philosophy of continued integration of DT and OT.

The balance of this issue is devoted to articles to acquaint you with the southern flank of "AMERICA'S RANGE." Colonel Keyner, EPG's Commander, discusses a **"Partnership into the Future,"** covering the proving ground's long-standing relationship with the U.S Army Operational Test Command and touching on a few of the many success stories of joint and combined DT/OT accomplished through the working partnership. In another article, Alan Morris describes the special support being provided to the **Central Technical Support Facility at Fort Hood, TX.** The customer for that program is the Program Executive Officer, Command, Control, and Communications Systems. Successful development and testing of these systems will lead to an Army supported by digital systems technologies. An article by Gerardo Lopez, **"Data Hunter and TINA Fly with STARSHIP,"** provides an overview of distributed systems testing, highlighting some of the leading edge technologies employed to accomplish technical testing at hundreds of different locations in a very tightly controlled environment.

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Inside This Issue

"TestBytes"

These are short news briefs on test happenings of general interest. Generally restricted to one paragraph, they "snapshot" the major testing topics around the world. We attempt to pass topics of interest to you in small " bites," and where possible, direct the reader to sources providing more information on a particular topic.

Home of the "Buffalo Soldiers." Fort Huachuca, AZ, dates to March 1877 when two companies of the 6th Cavalry set up camp at the mouth of Huachuca Canyon to protect settlers and to intercept Apache raiders escaping to Mexico. In 1882, it was made a permanent post and remained through the days of Geronimo. The all-black 10th Cavalry known as the "Buffalo Soldiers" under General Pershing arrived in the high desert outpost in 1913 and guarded the border until 1931. Declared surplus after World War II, the post was reactivated during the Korean War and turned over to the Signal Corps in 1954. The area was considered ideal for electronics and communications testing, and is today the Army's Electronic Proving Ground (EPG). This edition of the DTC Technology Report features this unique proving ground as it begins to write a new century of history.

TTS 2001 Addresses T&E Contributions to Total Ownership Cost Reduction (TOCR). The U.S Army Test and Evaluation Command showcased some of its latest technologies at the Turf Valley Resort and Conference Center in Ellicott City, MD, on May 1 & 2, 2001. Planning around DOD's current program to reduce total ownership cost of military systems, the testers described how they can contribute. John Gehrig, DOD's Deputy for Resources and Ranges, opened the symposium, followed by several program managers whose programs have been designated as TOCR pilots. Six demonstration areas were set up to show actual technologies in action. The symposium proceedings will be posted on the DTC website at http://www.dtc.army.mil.

High-Speed Digital Camera Ready for Tester Use. Testers can now buy a camera which takes up to 500 pictures per second with 512 X 512 pixel resolution (film quality), with an electronic shutter capable of speeds up to 1/20,000 of a second. The 5.2 pound camera can withstand high-vibration levels and operate from +55°C to -50°C. The Navy used 16 cameras on a F/A-18E Super Hornet in March 2000 to record separation of an attack munition. The Army used these cameras at Yuma Proving Ground to record rocket launches from the Multiple Launch Rocket System. You can get more information from the camera manufacturer, DRS Technologies Inc., in Parsippany, NJ; phone (973-898-1500) or email info@drs.com. (Source: ITEA Journal, September/October 2000).

Workshop Renews Interest in Natural Environmental Testing. Army developers, testers, evaluators, and warfighters gathered in Baltimore, Maryland, on November 29 and 30, 2000, to study the need for testing new systems, weapons, and materials at remote sites characterized by natural environmental extremes. Experts from across the United States and one Canadian scientist delivered papers which were followed by work sessions to "scope the problem" and share ideas. The "report-out" from the workshop was sent to LTG Paul Kern (Director, Army Acquisition Corps), Walt Hollis (Army Deputy for Operations Research), and General John Coburn (Commander, AMC). The principal finding was a need to include appropriate natural testing in program requirements documents as a part of an integrated modeling, simulation, chamber testing, and field validation process. You can review workshop proceedings by visiting DTC's website: http://www.dtc.army.mil.

EPG's Compact Range Incorporates 75-Foot Reflector. An important measurement in antenna testing is angle of arrival of the phase front. Accurate measurement of this angle requires a "flat" wavefront which in free space is attained at a distance of about 30 miles. The testers at EPG's Compact Range have developed a way to obtain the necessary measurements in a relatively small test arena. Their test setup includes a 75-foot diameter parabolic reflector that produces a collimated beam of parallel rays with a flat wave front with a radiation path only 300 feet long. You can read more about the operation of this antenna test operation in the article "Testing IEW Equipment in the Desert" beginning on page four of this issue.

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AMERICA'S RANGE -THE SEQUEL
Electronic Proving Ground

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Tommy Romanowski covers the EPG role in **Intelligence and Electronic Warfare (IEW)** systems testing in the article entitled "Testing IEW Equipment in the Desert," providing some details on their unique test facilities. Rosa Barrineau's article **"Cospas-Sarsat Saves Lives"** describes EPG's vital role in the beacon radio certification program, an international interest project. As the only laboratory in the western hemisphere to conduct Cospas-Sarsat certification testing, EPG's unique capability is part of the White Sands National treasure. Bob Reiner covers some features of the **Instrumented Test Range** and field test capabilities located at EPG.

A 47-year legacy of electronic testing technology

EPG continues to build upon its 47-year legacy of exploring new technology, applying it to the Army's communication-electronic business, and then validating the newly applied capability to support our warfighters. Digitized technology is the wave of the future, and EPG continues to be there to enable the Army to meet its modernization challenges.

You can reach Colonel Keyner at (520) 538-8888; DSN 879-8888; or Mr. Cole at (520) 538-8010; DSN 879-8010.

Partners Into the Future

EPG and OTC Team Up to Provide High-Quality C4I Testing

Colonel Hugo Keyner, Commander, and David H. Kelso, Chief, Test Engineering Division, WSMR-Electronic Proving Ground

Historically, the Electronic Proving Ground (EPG) and the Army's operational test organization known as the U.S. Army Operational Test Command (OTC) have worked closely together over time to provide Army decisionmakers with the highest quality information needed to make the best decisions possible concerning Command, Control, Communications, Computers, and Intelligence (C4I) systems. C4I is an umbrella term, which includes radio, telephone, and computer communications, as well as intelligence collection and electronic warfare efforts.

The majority of components within C4I systems consist of computer parts and software and are carried by Army ground vehicles, aircraft, or Unmanned Air Vehicles. These configurations have historically lent themselves to testing environments which combine both an operational and developmental test flavor. Also, due to the computer and software intensity of these systems, they have lent themselves to automated, computer-based data collection and stimulation using simulated or virtual components which are described elsewhere in this issue.

Testing of Mobile Subscriber Equipment (MSE) suggested a need for a better way

Early in the 1980's, smart people within EPG and OTC realized that important data were being collected during separate developmental testing (DT) and operational testing (OT). However, the dilemma faced by people who wanted to use data from both types of tests, was that there was no way to normalize the data so that it could easily be used to support one continuous analysis of a system. It was like trying to compare apples and oranges. This occurred because each test was independently planned, and data were collected for two different purposes using different methods and formats.

The Mobile Subscriber Equipment system known as MSE, which appeared on the test scene in the late 1980's, was the Army's first truly distributed tactical system. The MSE also had a very accelerated acquisition strategy with the Government only performing the OT. The contractor was responsible for all technical or DT. As the acquisition program proceeded, DT was found to be limited to individual sheltered systems which were components in the MSE system of systems. As a result, a gaping hole was left in the collection of technical test data for the system.

The MSE test program presented the operational tester his own set of unfulfilled needs. A method was required to get information to the operational test director enabling him/her to know what was going on within such a distributed system when components were scattered across hundreds of square miles. This knowledge was required to direct data collectors, maintainers, and other test support personnel. The same information was also needed for data reduction and problem definition. It was critical to differentiate problems to be charged to the system under test from those not to be charged. For example, it was important to not count (charge) failed messages if a Government-furnished generator failed and the communication failed as a result of losing power. The solution to both dilemmas (test director realtime awareness and problem definition) involved the collection of information which would permit the collection of technical (or developmental) test data, while at the same time permitting the operational test director

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Partners Into the Future

EPG and OTC Team Up to Provide High-Quality C4I Testing

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to have a picture of test situational awareness, as well as an automated ability for test command and control. Recognizing these shortfalls, an approach to meet both OT and DT needs was agreed upon by both proponents. The solution required the development of a new Test Control Center which could be used in both technical and operational tests. Also required was a new approach to a test item driver, or stimulator. Although EPG's Test Item Stimulator (TIS) had been used satisfactorily for years for the DT environment, it required miniaturization and ruggedization to meet the stringent requirements and transparency of OT. The new design was accomplished and is referred to as the "Micro-TIS." Similar cooperation was achieved in the software area. Since much of the same instrumentation was used in both DT and OT, it was only a matter of common sense that collected data be handled, reduced, and analyzed using the same computer algorithms and computer programs, which has in fact occurred over time as a result of increased collaboration between the two commands.

Although conceptionally simple and obvious, this process triggered by the MSE test program broke many paradigms in both organizations. Once broken, new paradigms of joint EPG/OTC partnership have been developed and reinforced over time resulting in both organizations leveraging on each other's strengths to provide high-quality data at the lowest possible price for the Army.

Historically unique working partnership with the operational tester produces high-quality data at the lowest cost to the Army

Today, EPG routinely provides test command and control services and local area network data collection services to OTC during operational tests and Army Warfighting Experiments (AWE's) involving distributed systems, while OTC provides EPG with data reduction services during developmental tests. Additionally, both EPG and OTC have initiated projects for joint development of instrumentation such as the Improved Field Data Collection device to collect tactical C4I communication and data traffic from moving vehicles such as tanks, artillery, and HMMWV's.

The above described initiatives and testing concepts illustrate a historically unique working partnership with the operational tester within the U.S. Army Developmental Test Command. This partnership has resulted in Army savings of millions of test dollars over the past two decades. Savings have been realized on Army Battle Command Systems such as the following:

- Force XXI Battle Command Brigade and Below (FBCB2)
- Task Force XXI AWE
- Division XXI AWE
- Joint Contingency Force AWE
- Other Army digitization and electronics modernization programs

However, the past is not the future, and EPG shall work with OTC to support FBCB2 Field Test 4, the Digital Capstone Exercises, and multiple joint force AWE's such as Millennium Challenge 2002 and Olympic Challenge 2004.

EPG's approach to C4I testing has saved the Army millions of test dollars over the last two decades through our partnership with OTC. As we move further into the 21st century, this partnership shall be reinforced to continue to save millions more over the next decade.

You can reach Colonel Keyner at (520) 538-8888; DSN 879-8888; or Mr. Kelso at (520) 533-8104; DSN 821-8104.

Testing IEW Equipment in the Desert

Tommy K. Romanowski, Chief, IEW & BS Branch, WSMR-Electronic Proving Ground

The increased sophistication of military intelligence and electronic warfare (IEW) components and systems requires a parallel degree of sophistication in testing technology. As a result, the cost of testing these systems has risen. The Electronic Proving Ground (EPG) has responded with a closed-loop method of testing which cuts the cost of Government testing in half and provides complete and repeatable results not always accomplished in range testing. The new approach to testing IEW equipment combines a closed-loop methodology and some unique facilities. The Antenna Test Facility for antenna effects testing, the Virtual Battlefield Environment Facility for system performance, and the southwestern Arizona Open-Air Range have proven to be effective in performance testing of new IEW equipment.

These unique facilities at EPG are responding to the need for performing extensive testing of elaborate IEW systems after they are installed on vehicles. In the past, equipment was extensively tested at the contractor's facility prior to being installed on the vehicle. After installation, field tests (technical or developmental tests) were conducted by moving the test vehicle on a range against single or multiple threats, and the data were recorded. If the system performed to the expected level, continued operational testing was then recommended by the technical tester. Although this method was adequate, many man-hours were required to run the tests, increasing the cost for personnel (salary and travel expense) and range use (facility and transportation to facility).

EPG's current approach cuts

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Testing IEW Equipment in the Desert

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overall test cost by decreasing man-hours and providing a convenient and well-equipped set of test facilities. Three facilities are the foundation for EPG's capability for determining the performance of any system under test (SUT).

EPG's closed-loop method of testing cuts cost of Government testing in half and provides complete and repeatable results

The Antenna Test Facility tests and evaluates, under controlled conditions, the direction finding accuracy and test vehicle structure effects on the antenna. The Virtual Battlefield Environment (Simulation/System Stress) Facility simulates the electromagnetic stress conditions and determines the limits of the IEW performance capability through comprehensive testing within a controlled laboratory environment. Finally, there is a facility for range open-air testing to collect data to re-enforce the simulation effort. The importance of these facilities merits a brief explanation of how each operates.

Antenna Test Facility *(Section contributed by Henry Sylvia, IEW & BS Branch).* EPG's Antenna Test Facility (figure 1) offers three antenna ranges: the Compact Range, the East Turntable, and the Arc. A typical test sequence follows.

First, the SUT with all IEW equipment installed is mounted on a turntable. This equipment, complete with a tunable programmable emitter and an antenna mounted on the nonmetallic tower 500 feet from the turntable, provides the proper environment to generate the appropriate test signal. Safety of the test personnel and test vehicle crew mandates the use of this open-air facility. The test source antenna, the test vehicle, and the turntable are aligned such that the source and the test vehicle are bore-sighted at 0° with the test vehicle pointing towards the source. The turntable is rotated, changing the respected position of the test vehicle to the emitter, and angle of arrival (AOA) data recorded. Transmit frequencies are at the low, mid and high bands of the IEW spectrum.

The SUT is then "powered up" and operated. Measurements of direction finding capability are taken over the full 360° in 5° increments with the IEW system operating.

The Compact Range illustrated in figure 2 is used to establish a planar wave so that AOA data can be taken accurately without phase distortion. Far field ranges exhibit the undesirable trait such that the wavefront of the nearby-transmitted signal is geometrically an arc. Accurate AOA data require that the signal have a "flat" wavefront to avoid large undesirable phase errors. Two ways to achieve this are to move the test item far enough from the emitting antenna that the signal is spread out far enough to look essentially flat to the receive antenna, or to use EPG's Compact Range. The Compact Range uses a specifically designed parabolic reflector 75 feet in diameter and feed arrangement that produces a collimated beam of parallel rays with a flat wavefront within a radiation path only 300 feet long. Normally this would have to occur over distances greater than 30 miles.

Precise rotation of test vehicles enables measurements of angle of arrival from all aspects

The SUT with the IEW installed is mounted on the Compact Range's calibrated positioner. The positioner is capable of rotating 0° to 360° or tilting the test vehicle from 0° to 90°. The reflector, the test vehicle, and the positioner are aligned such that the source and test vehicle are bore-sighted at 0° with the test vehicle headed toward the reflector. The positioner is rotated, changing the respective position of the test vehicle to the emitter, and AOA data recorded. Direction finding measurements are made every 5° over the full 360° of the positioner with the IEW operating. The radio frequency (RF) source is operated at 18 discrete frequencies over the frequency range of the IEW equipment. In order to determine the performance of the azimuth measurements at elevations other than 0° relative to the emitter source, the above is repeated with the SUT tilted 10°.

Virtual Battlefield Environment Facility (VBEF). The VBEF is an integrated hardware simulation test facility capable of generating realistic, dense electromagnetic environments while simultaneously monitoring the performance of the IEW system via the bus monitor and recording the video

Figure 1. Antenna Test Facility (ATF).

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Testing IEW Equipment in the Desert

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from the multifunctional display of the SUT (figure 3).

The VBEF bridges the gap between computer simulation and full-scale field testing. Field testing is expensive, and pure simulation has the disadvantage of using only computerized representations rather than actual equipment. The biggest advantage is that the entire system is being tested at system level. The purpose of the VBEF testing is to determine the limits of the IEW's performance capability through comprehensive testing within a controlled environment. The equipment is capable of generating stable, highly accurate signals over the frequencies covered by the IEW system. The background RF environment (airfield, communication, weather, etc.) affects the test results and is accounted for in the data analysis.

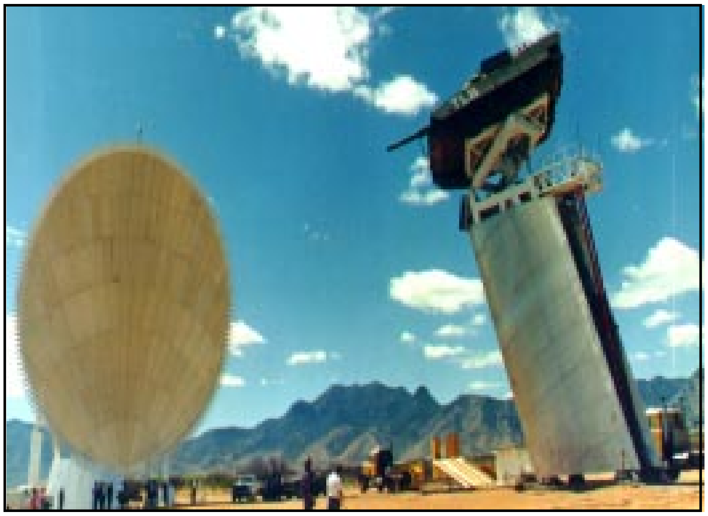

Figure 2. Compact Range with 75-foot parabolic reflector.

The VBEF testing consisted of a series of subtests. These were the single emitter, the multiple emitters with static scenario, the multiple emitter with dynamic scenario, and RF sensitivity subtests.

Range Open-Air Facility. Open-air testing evaluates the performance of the IEW in a controllable but more realistic SUT mission environment than those of previous phases. An open-air test of an airborne IEW system is shown in the photograph (figure 4).

The primary aim of this phase is to determine the effectiveness of all IEW systems in supporting an operational mission. This is done by moving the IEW system against test range threat emitters that represent threats expected to be encountered during a real operational mission. The threats are both real and simulated. During open-air testing, impressions formed and data collected are used to determine the degree the IEW system is ready for operational testing and subsequent production. System operation, interoperability, and utility under expected range conditions are evaluated in this final phase of effectiveness testing. Open-air test data are also compared to the VBEF data to give some validity to more stressful simulation testing.

Combining Capabilities. EPG is effectively meeting the challenge of testing sophisticated new IEW systems by combining open-air range testing with specially designed closed-loop facilities to assess capabilities to operate in intended operational environments. The Antenna Test Facility provides the antenna measurements. The VBEF provides simulation and modeling. The open-air field operations add the man-in-the-loop aspect. Each of these phases provides input to the others for a complete evaluation. The results will also be used to better simulate follow-on testing or testing other similar systems. The advantages of EPG's test method are as follows:

- Dollar savings from reduced open-air testing
- Cost-effective simulation to answer more of the issues
- Extremely accurate antenna patterns and angle of arrival data
- System tested beyond practical field test limits
- Absolutely reproducible results

The Bottom Line. As IEW systems continue to become more advanced, the testing community must also develop methods and facilities to keep pace. EPG's closed-loop testing improves usage and adaptation of existing facilities to uncover potential uses that are both cost effective and provide better test data at lesser cost for these

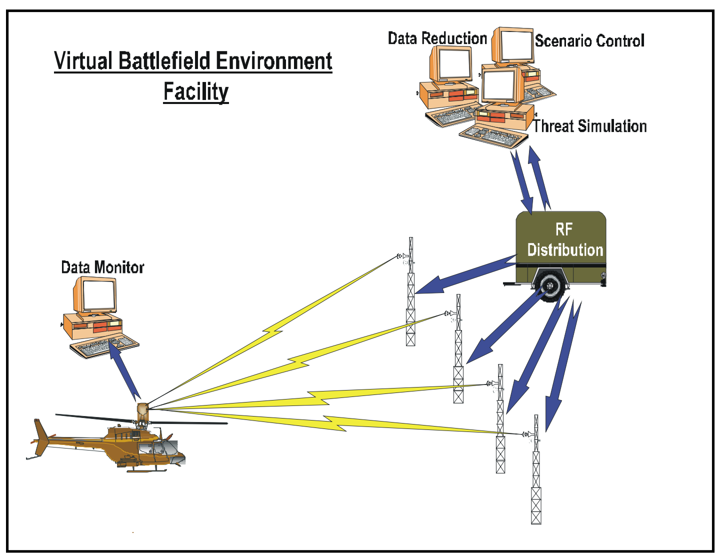

Figure 3. Virtual Battlefield Environment Facility.

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Testing IEW Equipment in the Desert

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advanced systems. The bottom line is that the EPG closed-loop method of testing cuts the cost of Government testing in half and provides complete and repeatable results not always accomplished in range testing. Achieving the same results in open-air testing would require an exorbitant amount of man-hours for testing and data reduction resulting in many additional test hours and thereby a longer wait for the test report.

For additional information, you may contact Tommy K. Romanowski at (520)538-2303; DSN 879-2303; or email Tommy.Romanowski@epg.army.mil.

Figure 4. Open-Air Test Range.

"Cospas-Sarsat" Saves Lives

EPG Certifies Beacons for International Search and Rescue

Rosa Barrineau, Program Manager, WSMR-Electronic Proving Ground

The title alone should pique your interest and cause you to read on. Over the past 4 years, testers at the Electronic Proving Ground (EPG) have been supporting an international program which involves 29 nations. Although "Cospas-Sarsat" is not a household name, the program might someday save your life. The system has saved more than 11,400 lives worldwide, and more than 4,000 lives in the United States since its inception in 1982. This international search and rescue system operates with low earth orbiting and geostationary satellites. The acronym "Sarsat" stands for Search And Rescue Satellite-Aided Tracking system. "Cospas" is the Russian equivalent acronym. The beginnings of Cospas-Sarsat date back to 1970 when a plane carrying two U.S. congressmen crashed in a remote region of Alaska. A massive search and rescue effort was mounted, but to this day, no trace of them or their aircraft has ever been found.

After this incident, Congress mandated that all aircraft in the United States carry an Emergency Locator Transmitter (ELT). The initial ELT's used 121.5 MHz, the international aircraft distress frequency. This frequency was cluttered, and the signal had to be within range of a rescuing aircraft. After several years of inefficiency, ELT's began to outweigh their benefits, and a satellite-based system was conceived. It would operate on a frequency reserved only for emergencies. The Sarsat system was developed in a joint effort by the United States, Canada, and France. The Cospas system was developed in the Soviet Union. These four nations banded together in 1979 to form Cospas-Sarsat. In 1982, the first satellite was launched, and by 1984 the system was declared fully operational.

Since 1984, the Cospas-Sarsat organization has continued to grow. The four original member nations have now been joined by 25 other nations that operate 28 ground stations and 15 mission control centers worldwide or serve as search and rescue points of contact. The Cospas-Sarsat system is an international, humanitarian, cooperative search and rescue program, using U.S. and Russian satellites to detect and locate emergency beacon signals from people in distress. The National Oceanic and Atmospheric Administration (NOAA) is responsible for administering and operating the system in the United States. The Cospas-Sarsat International Organization continues to be a model of international cooperation.

Alaskan aircraft crash triggers new search and rescue research

Aircraft using the new rescue system still carry a small ELT. Boats employ a similar beacon called an Emergency Position-Indicating Radio Beacon. Hikers and individuals operating in remote areas can use a Personal Locator Beacon. In the event of a life-threatening emergency, the beacon is activated either manually or automatically and sends a distress message. The system is able to locate the beacon within 2-5 kilometers using doppler processing techniques. Additionally, the system is able to more precisely locate beacons containing embedded location data. The data in message format is transmitted to the Mission Control Center which distributes this data to the Rescue Coordination Centers for appropriate action.

U.S. and Russian satellites combine to detect and locate emergency beacon signals from people in distress

In July 1996, Karen Anthony and James Cole of EPG were approached about becoming a certification facility for beacon manufacturers. After many detailed discussions between NOAA, the National Aeronautics and Space Administration, and EPG, a test of a certified beacon was conducted to ensure that EPG met the certification requirements to become a type approval facility. This was successfully completed on July 25, 1997.

EPG became the home of a new international test facility on September 4, 1997, with the dedication of the

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"Cospas-Sarsat" Saves Lives

EPG Certifies Beacons for International Search and Rescue

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Cospas-Sarsat Beacon Testing Facility. It is the only such facility in North or South America.

A good example of sharing of military test technology with the commercial market

The new facility conducts certification testing on emergency beacons designed for use in maritime, aviation, and portable applications. Manufacturers of beacons are required to have new or modified designs certified at a Cospas-Sarsat-approved facility before they can be sold. Prior to September 1997, U.S. manufacturers had to coordinate with a laboratory in the United Kingdom or France, which often caused time delays, complicated logistics, and higher costs. They can now come to EPG.

According to James T. Bailey, Cospas-Sarsat Program Director for NOAA, "The real beauty of the EPG test lab is that it uses already existent public facilities to fill a need." This is truly a win-win situation for all involved. Beacon manufacturers benefit by working with a test lab in their home country, and taxpayers benefit by a fuller utilization of an existing resource. EPG has been testing electronic devices since 1954 and will be able to apply their experience and expertise to emergency beacons. This effort marked the entrance of EPG into supporting humanitarian search and rescue technologies, and also represents the use of military technological capabilities in the commercial market.

The EPG team continues to test and certify beacons for various manufacturers. In 2000, EPG was recognized as an independent test facility for the Coast Guard for Radio Technical Commission for Maritime Services (RTCM). Beacon manufacturers have to meet Cospas-Sarsat certification requirements as well as RTCM requirements. EPG is currently working with the Federal Aviation Administration, the Federal Communications Commission, and the Canadian Cospas-Sarsat secretariat to be recognized as an independent test facility and certification facility for ELT and Canadian requirements.

For more information contact Mrs. Rosa Barrineau, Program Manager, (520) 533-8323; DSN 821-8323; or Mrs. Karen Anthony, Program Director, (520) 538-3831; DSN 879-3831.

Central Technical Support Facility at Ft. Hood

Certifying Battle Command System Software

Alan Morris, WSMR-Electronic Proving Ground, Fort Hood Field Office, Fort Hood, Texas

The Program Executive Office, Command, Control, and Communications Systems (PEO, C3S) founded the Central Technical Support Facility (CTSF) at Fort Hood, TX, in 1997 to integrate and field the Army Battle Command System (ABCS) into the Army's Force XXI Program. This is a formidable job! The following extract from the PEO, C3S mission statement defines this job and is the basis for the support facility.

> "...act as an enabler for the rapid integration of dissimilar hardware and software through real time interaction with the soldiers, program managers, contractors, and the requirements community."

In establishing the CTSF, the PEO selected the Electronic Proving Ground (EPG) as its test team for integrating, testing, and certifying ABCS software. The EPG support effort began in 1997 with two Government civilians and four support contractor representatives. The team now has a core of five Government civilians, and nine contractor representatives, with augmentation as needed from EPG staffs at both Fort Lewis, WA, and Fort Huachuca, AZ. The EPG test personnel have expertise in each of the five battlefield functional areas, and this creates a strong and effective test team.

It was recognized that the key to the success of the facility would be its ability to respond to changing functionality of ABCS software. This is being accomplished via EPG's Command, Control, Communications, Computers, and Intelligence (C4I) toolkit which provides the flexibility to adapt instrumentation, data collection, and after-action review tools. This array of seven tools is the common thread seen in ABCS integration/test, operational testing, and user training of fielded digital systems. Figure 1 depicts the interrelationship of these tools.

One or more of these seven tools (test control, stimulation, digital data collection, data consolidation, quick look reduction, data analysis, and after-action review (AAR) tools) are used to support the CTSF mission, depending upon test requirements.

STARSHIP, the Controller Tool. Test control of test instrumentation within the CTSF is being accomplished by STARSHIP, an EPG-developed test control center. STARSHIP monitors and controls the test instrumentation via the local area network (LAN), and displays the location and status of all data collection devices.

Stimulation, Digital Data Collection, and Consolidation Tools. The Multi-Function Data Collector (MFDC) is the heart of the instrumentation within CTSF. This umbrella program runs several specialized subordinate modules that include digitized message text format stimulators, traffic generators using various protocols, a tactical radio injection module, and modular covert remote electronic warfare stimulators. The digitized Army stimulator is capable

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Central Technical Support Facility at Ft. Hood

Certifying Battle Command System Software

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of exchanging joint or U.S. message format messages with Force XXI Battle Command, Brigade and Below or ABCS nodes. A module called a "pinger" sends echo requests to other nodes according to a user-defined schedule. Pinger data can be used to build a network reachability time line. The size, rate, and list of addresses are user selectable.

Data collection is accomplished by the MFDC using a High-Speed LAN Tap (HSLT) and Wide Area Network tap (WAN tap). The HSLT collects data from the LAN or upper Tactical Internet and the WAN tap collects radio data in a laboratory environment. Data consolidation within the CTSF is over the LAN (HSLT) or data radio (WAN tap), and can be done in near realtime or after the test.

Quick Look Reduction, Data Analysis, and After-Action Review (AAR) Tools. Reduction is accomplished by the Data Processing Unit (DPU), which turns raw data into human readable information and places it in a data base. In a realtime environment, data are fed from the HSLT or WAN tap, to the DPU via a Real Time Aggregation (RTA) unit. The RTA maintains the connection to collection devices and ensures data delivery. The DPU data are used by a Graphical Real Time Analyzer to provide quick look information and realtime analysis indicators.

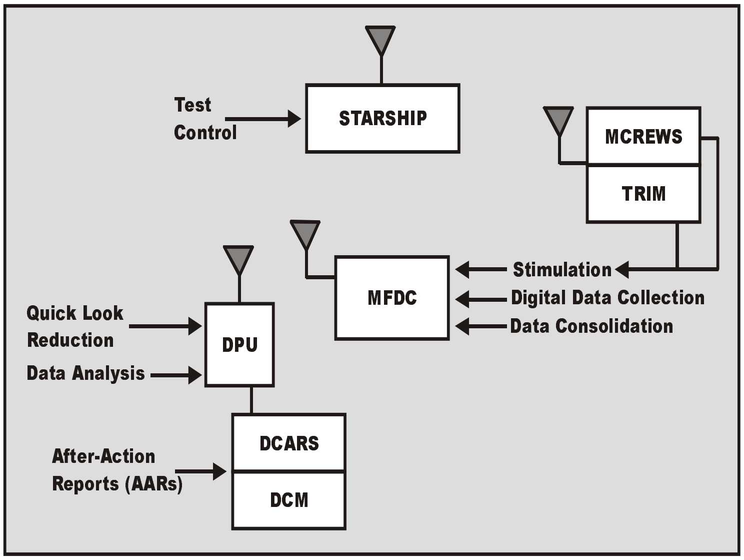

Figure 1. The C4I toolkit.

The AAR tool in the C4I toolkit is the Digital Collection, Analysis, and Review System (DCARS). DCARS uses DPU output as well as data base queries performed by the MFDC in ABCS 4.3 and earlier and the Data Collection Module (DCM) in ABCS 6.xx and beyond, to create AAR products. The DCM is a common software module and resides on ABCS computers as one of the foundation systems. This allows similar data to be compared for commonality among various ABCS systems.

In summary, the EPG part of the CTSF depends upon the C4I toolkit and the test personnel expertise. The effective merger of people and tools and the dynamic partnership with PEO, C3S are getting a difficult job accomplished. This approach assures the continuing capability to provide necessary data for software certification as the ABCS matures to full battlefield readiness.

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Data Hunter and TINA Fly with STARSHIP

Distributed System Testing

Gerardo Lopez, Chief, Distributed Systems Branch, WSMR-Electronic Proving Ground

Testing is a vital part of the acquisition programs for Command, Control, Communications, Computers, and Intelligence (C4I) systems and providing the necessary testbeds is a continuing challenge to the tester. With more than 20 years experience in conducting field tests of distributed C4I systems and a program dedicated to implementation of emerging technologies, the Electronic Proving Ground (EPG) is meeting the challenge. With testing roots in distributed command, control, and communication systems such as Mobile Subscriber Equipment, Enhanced Position Location and Reporting System, and Army Tactical Command and Control System, EPG is preparing for the future as the Army Battle Command System (ABCS) evolves the system of systems concept.

To address the challenge, program managers for Tactical Radio Communication Systems and Force Battle Command Brigade and Below (FBCB2) sponsored the establishment of the Tactical Internet (TI) and FBCB2 testbeds at EPG. The testbeds are designed to continually support the PM's testing programs. After completing bench and in-plant testing, the contractors' test strategy provides for field tests in the Fort Huachuca desert. The test design requires a representative slice of the system's operational architecture, typically consisting of 40 to 65 nodes (points in the communications network). The nodes are disbursed over operational tactical distances with connectivity provided with "real" over-the-air communication links. Using this

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Data Hunter and TINA Fly with STARSHIP

Distributed System Testing

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controlled distributed test environment, EPG can assist the contractors in further testing of their systems and identification of issues that were not encountered during the lab and in-plant testing.

EPG meeting the challenge of testing the Army Battle Command System

The scope of a distributed test varies based on customers' needs. Field tests have varied from a small 20-node integration test deployment with its accompanying Tl communications, to well over 100 nodes of a multitude of communication, command, and control systems during a Government developmental test. Field Test 3 (FT3) of FBCB2 is an example of a system of systems Government developmental test. The test structure consisted of a slice of a two brigade architecture containing parts of five Tactical Operational Centers elements with up to 80 FBCB2 nodes with its complement of TI and near-term data radio communications dispersed across the Fort Huachuca ranges. Figure 1 lists the systems in the test architecture that illustrate the complexity of the test.

Critical to the success of this type of testing is the set of instrumentation tests tools. Partnering efforts among the project managers, their developing contractors, developmental and operational testers, and evaluators have evolved a set of test tools used by all. The focus in developing the test tools is not only in support of the tester and evaluator but also in direct support of the PM's and their developing contractors. The test tools provide stimulation, data collection, data reduction and analysis, and an overall operational capability to centrally monitor and control the tests. It is this set of test tools that provide testers the complete package to produce the necessary products to all customers at the end of a test.

Stimulation tools create a simulated environment of over 600 missing nodes providing command and control (C2) message stress loading within and across brigades. Using the tools allowed EPG to conduct a test that not only met the requirements of the evaluators, but produced information useful to developer engineers in troubleshooting problems encountered with systems under test. During the FBCB2 FT3, all the systems under test were instrumented. Stimulation tools such as Simulation, Testing, Operational Rehearsal Model, and a digitized Army message stimulator allowed the tester to create a simulated environment of over 600 missing nodes and also provide capability for situational awareness and C2 message stress loading within and across brigades. Data collection tools like the Improved Field Data Collector and High-Speed LAN Tap collected all the digital data across the architecture. Using specialized reduction and quick-look tools such as Data Hunter on collected data helped identify causes for anomalies experienced during the test. Using data reduction products such as Tactical Internet Network Analysis (TINA) and Operational Tester Level III reduction tools provided each customer (PM, tester, evaluator, and developing contractor) the necessary information to address their requirements or questions. A data network the size of FT3 requires processing gigabytes of data every day, but because of the maturity of the data reduction products, the data and products were ready for review in less than 24 hours. The ultimate challenge in tests of this magnitude is to maintain command and control and know whether the testing is proceeding according to plan. This necessary capability is afforded through the use of the Test Control Center or STARSHIP test tools. Without them, a test of this magnitude would be virtually unmanageable.

COMMUNICATION SYSTEMS	
SINCGARS	Single Channel Ground Airborne Radio System
EPLRS	Enhanced Position Location Reporting System
INC	Internet Controller (Tactical Internet Router)
NTDR	Near-Term Data Radio
MSE	Mobile Subscriber Equipment (Simulated - EPG LAN)
TIMS	Tactical Internet Management System
UAV CRP	UAV Communication Relay Payload (CRP)
COMMAND AND CONTROL SYSTEMS	
FBCB2	Force XXI Battle Command Brigade and Below
MCS	Maneuver Control System
ASAS	All Source Analysis System
AFATDS	Advanced Field Artillery Tactical Data System
AMDWS	Air and Missile Defense Workstation / Co-Host
CSSCS	Combat Service Support Control System
PLGRS	Precision Lightweight GPS Receiver System

Figure 1. Field Test 3 systems.

Testing of distributed C4I systems continues to be a formidable task. Additional systems are being fielded and integrated into the ABCS umbrella, and systems-of-systems testing will be the norm. The test tools must continue to improve and evolve with the systems under test. The test tools must continue to be diverse providing data to support both developmental testing and operational testing evaluations, and also to providing insight to the PM's and the developing contractors throughout the testing. It is through partnering of the acquisition community that major strides will continue to be made in supporting the spiral development strategy and providing a better product to the ultimate customer, the warfighter.

For more information, contact Gerardo Lopez at (520)533-8117; DSN 821-8117.

EPG Instrumented Range Operations

Robert Reiner, Technical Director, WSMR-Electronic Proving Ground

The vital mission of testing systems which will be the centerpiece of the digitized battlefield justifies the Electronic Proving Ground's (EPG's) status as a member of the Department of Defense (DOD) Major Range and Test Facility Base (MRTFB). To meet this responsibility, EPG has assembled a diverse set of capabilities that support Command, Control, Communications, Computers, and Intelligence (C4I) and other related testing. A significant part of this capability is the Instrumented Test Range (ITR) which supports open-air range test functions.

Range size and climate. The open-air range at EPG is unique within the DOD because of its naturally quiet electromagnetic environment, its unique specialized facilities, its close relationship with the Army training community, and the availability of the expansive real estate of southern Arizona. Operations are routinely possible on 70,000 acres at Fort Huachuca, 23,000 acres on Wilcox Dry Lake, more than 100,000 acres at Gila Bend, and with prior coordination, on approximately 62 million acres of federal- and state-owned land. The topography includes mountains, plateaus, and river bottoms. Due to the range's location on the northeast side of the Huachuca Mountains, this area is blessed with an almost ideal climate. Set well above, and 14 miles distant from the San Pedro River, and at an altitude of 5,000 feet above sea level, the range enjoys mild winters and pleasant summers. The January mean temperature is 46.2°F; the June mean temperature is 76.7°F. Average wind speed is 5.6 mph. With an average 330 clear days per year, in excess of 300 clear test days are assured.

The EPG ITR provides all those functions typically found on open-air ranges. These functions include time, space, and position information (TSPI), telemetry information, video tracking information, range communications, range control systems, and data acquisition and dissemination capabilities.

Ideal high desert climate assures 300 days of good testing

In addition to this range instrumentation, EPG has the runways and restricted airspace necessary to support aircraft test operations, an extensive foreign equipment simulation capability, and a series of radar measurement test facilities. TSPI is provided through the use of four precision tracking radar systems, a multilateration-based position location system, and a global positioning tracking system. A surveillance radar provides safety of flight information during test operations. Additionally, through agreements with the Federal Aviation Administration, EPG has access to flight traffic information for most of the state of Arizona. TSPI is provided throughout all of southern Arizona. Data that are available in the air or on the ground are retrieved through the three telemetry systems and/or custom designed data collection systems. Data are presented in the Central Control Facility and/or the EPG Test Control Center on large displays and are collected on the various computer systems. Data are provided to the customer in a variety of formats ranging from paper reports to realtime Internet access. Communication throughout the range is available through a trunked radio system which extends from New Mexico to the California border. Video data are available through either boresight cameras or a video operations van.

Figure 1. 12,000-foot runway supports airborne testing.

Testing of airborne systems. For those tests involving airborne systems, there are four runways on Fort Huachuca; the longest of which is 12,000 feet (figure 1). Two runways are paved, and two are dirt. There is a hangar located at the main runway, with ample space for several aircraft. If support aircraft are needed for testing, they are available from the Army Air Operations Directorate at U.S. Army White Sands Missile Range. With over 1,100 square miles of "restricted" airspace available in the vicinity, nonhazardous airborne testing is virtually unrestricted at Fort Huachuca.

Creating the environment. Many systems tested at EPG must be subjected to a realistic combat environment. The EPG Realistic Battlefield Environment consists of Communications Environment Systems (CES's) and foreign vehicles. The CES's consist of more than 100 foreign radio systems and U.S. manufactured surrogates (HF, VHF, UHF) normally installed in tactical vehicles. These CES's can be deployed to over 2,100 surveyed sites in and around Fort Huachuca and southern Arizona to emulate a dense threat radio frequency (RF) environment (either static or mobile) for testing intelligence and electronic warfare systems.

Over 2,100 surveyed sites in southern Arizona emulate a dense threat RF environment

There are other RF generating

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EPG Instrumented Range Operations

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devices such as radar and signal generator/amplifiers to provide a signals intelligence type environment. The foreign vehicles shown in figure 2 consist primarily of former Warsaw pact tactical wheeled and tracked armored personnel carriers and trucks, and may be used for systems under test requiring visual, infrared (IR), audio, and radar cross section signatures. Additionally, specialized equipment (jammers) is available to allow field vulnerability testing of various radar and C4I systems.

Testing air-to-ground radar. EPG maintains a number of facilities useful in the testing of Army air-to-ground radar capabilities. These facilities include the Radar Resolution Facility, a Geometric Fidelity Facility, a Radar Spatial Resolution Facility, and a set of infrared target boards. The Radar Resolution Facility is used to simultaneously measure the range and azimuth resolution of radar. The Geometric Fidelity Facility is used to determine the fidelity of mapping radar systems at up to 100 miles without any defiled shadowing of targets. The Radar Spatial Resolution Facility is used to measure resolution and spatial distortion of photographic and other image acquisition systems. The target boards provide the ability to do IR testing.

Figure 2. Warsaw pact vehicles used for signature testing.

In summary, as a customer-reimbursed MRTFB test organization, EPG can satisfy unique requirements for open-air testing. Customers supported include commercial contractors, foreign governments, and U.S. Government program managers. Availability of the latest facilities, tools, and techniques has ensured their satisfaction.

For more information, contact Mr. Robert Reiner, at commercial (520) 533-8012; DSN 821-8012; or email reinerr@epg.army.mil.

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